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$$Q_k m+nQ_{k-1}=P_k \ldots .(1),$$
$$P_k m+nP_{k-1}=Q_k A \ldots .(2).$$

Solving for n in (2) and making use of the relation $P_k Q_{k-1}-Q_k P_{k-1}=(-1)^k$ we get, $P_k^2-AQ_k^2=(-1)^k n$.

Also solved by *G. B. M. ZERR*.

143. Proposed by JOHN M. COLAW, A. M., Monterey, Va.

Solve $x+y+z+a=a \ldots .(1)$.
$x^2+y^2+z^2+u^2=b \ldots .(2)$.
$x^3+y^3+z^3+u^3=c \ldots .(3)$.
$x^4+y^4+z^4+u^4=d \ldots .(4)$.

Solution by MARCUS BAKER, Washington, D. C.

Let u, x, y and z be the roots of the equation

$$X^4-AX^3+BX^2-CX+D=(X-u)(X-x)(X-y)(X-z).$$

For X write $1/V$, whence

$$1-AV+BV^2-CV^3+DV^4=(1-uV)(1-xV)(1-yV)(1-zV);$$

whence $\log(1-AV+BV^2-CV^3+DV^4)$

$$\begin{aligned}&=\log(1-uV)+\log(1+xV)+\log(1-yV)+\log(1-zV),\\ &=-uV-\tfrac{1}{2}u^2V^2-\tfrac{1}{3}u^3V^3-\tfrac{1}{4}u^4V^4-\ldots\\ &\quad -xV-\tfrac{1}{2}x^2V^2-\tfrac{1}{3}x^3V^3-\tfrac{1}{4}x^4V^4-\ldots\\ &\quad -yV-\tfrac{1}{2}y^2V^2-\tfrac{1}{3}y^3V^3-\tfrac{1}{4}y^4V^4-\ldots\\ &\quad -zV-\tfrac{1}{2}z^2V^2-\tfrac{1}{3}z^3V^3-\tfrac{1}{4}z^4V^4-\ldots\\ &=-aV-\tfrac{1}{2}bV^2-\tfrac{1}{3}cV^3-\tfrac{1}{4}dV^4-\ldots\end{aligned}$$

whence $1-AV+BV^2-CV^3+DV^4=e^{-(aV+\frac{1}{2}bV^2+\frac{1}{3}cV^3+\frac{1}{4}dV^4+\ldots)}$

Developing the second member of this equation, remembering that

$$e^{-x}=1-x-\frac{x^2}{2!}-\frac{x^3}{3!}-\frac{x^4}{4!}\ldots$$

we have

$$1-AV+BV^2-CV^3+DV^4=1-a\left|\begin{array}{l}V\ -\frac{1}{2}b\\ \quad +\frac{1}{2}a^2\end{array}\right|\begin{array}{l}V^3\ -\frac{1}{3}c\\ \quad +\frac{1}{2}ab\\ \quad -\frac{1}{6}a^3\end{array}\left|\begin{array}{l}V\ -\frac{1}{4}d\\ \quad \left.\begin{array}{l}+\frac{1}{3}ac\\ +\frac{1}{8}b^2\end{array}\right\}\\ \quad -\frac{1}{4}a^2b\\ \quad +\frac{1}{24}a^4\end{array}\right|V^4-\ldots$$

Equating like coefficients, we have

$$A=a;\ B=\tfrac{1}{2}(a^2-b);\ C+\tfrac{1}{6}(a^3-3ab+2c);\ D=\tfrac{1}{24}[a^4-6a^2b+(3b^2+8ac)-6d].$$

Therefore u, x, y and z are the roots of the equations

$$X^4-aX^3+\tfrac{1}{2}(a^2-b)X^2-\tfrac{1}{6}(a^3-3ab+2c)X+\tfrac{1}{24}(a^4-6a^2b[8ac+3b^2]-6d)=0.$$

The *method* here used I obtained many years ago from my old friend James Main of the Coast and Geodetic Survey who died in Washington November 23, 1894, aged 84 years. This method is *general* applying to a set of n equations containing n unkown quantities.

If we have

$$x+y+z+\ldots.=a$$
$$x^2+y^2+z^2+\ldots.=b$$
$$x^3+y^3+z^3+\ldots.=c$$
$$\cdot \quad \cdot \quad \cdot \quad \cdot$$
$$x^n+y^n+z^n+\ldots.=k$$

then are x, y, z, etc., the roots of

$$X^n-AX^{n-1}+BX^{n-2}-CX^{n-3}+\ldots.\pm K=0,$$

where

$A=a$

$B=(1/2!)\ [a^2-b]$

$C=(1/3!)\ [a^3-3ab+2c]$

$D=(1/4!)\ [a^4-6a^2b+(8ac+3b^2)-6d]$

$E=(1/5!)\ [a^5-10a^3b+5a(4ac+3b^2)-10(3ad+2bc)+24e]$

$F=(1/6!)\ [a^6-15a^4b+5a^2(8ac+9b^2)-15(6a^2d+8abc+b^3)+2(72ae+45bd+20c^2)-120f]$

$G=(1/7!)\ [a^7-21a^5b+35a^3(2ac+3b^2)-105a(2a^2d+3bc+b^3+b^2c)+14(24a^2e+20ac^2+15b^2c+45abd)-84(10af+6be+5cd)+720g]$

Solved in an excellent manner by *G. B. M. ZERR.*

144. Proposed by F. P. MATZ, Sc. D., Ph. D., Professor of Mathematics and Astronomy, Defiance College, Defiance, Ohio.

Show that the number of ways in which 15 different problems may be distributed among 5 students so that each student shall have three of them, is $N=(5.3)!/(3!)^5$.

Solution by G. B. M. ZERR, A. M., Ph. D., The Temple College, Philadelphia, Pa., and M. E. GRABER, Heidelberg University, Tiffin, Ohio.

It is demonstrated that the number of ways $a+b+c+\ldots.$ can be divided into groups containing a things in one group, b in another, etc., is

$$\frac{[a+b+c+\ldots.]!}{[a!][b!][c!]\ldots.}.$$